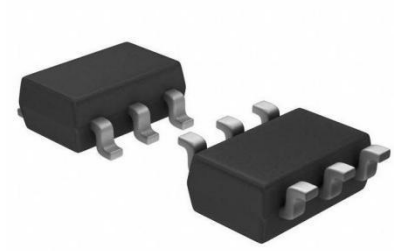
SCM1208BTA Transformer H-Bridge Driver for Isolated Supplies

Features

- H-Bridge Driver for Small Transformers
- Built in power MOS tube
- Soft drive for startup or overload
- Output short circuit protection
- Over temperature protection
- Highly symmetrical and quasi complementary drive

Packaging



Optional Packaging of Product: SOT-23-6,please refer to "Order Information" for details of silk screen.

Application

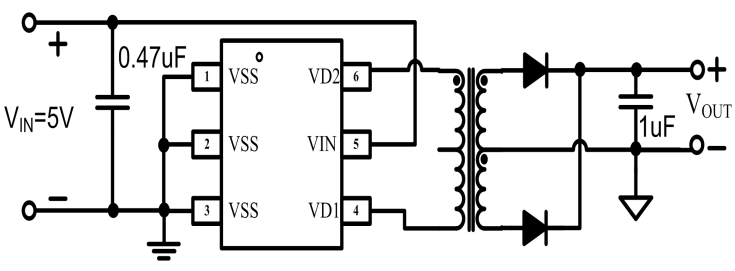
- DC-DC Isolation Converter

Description

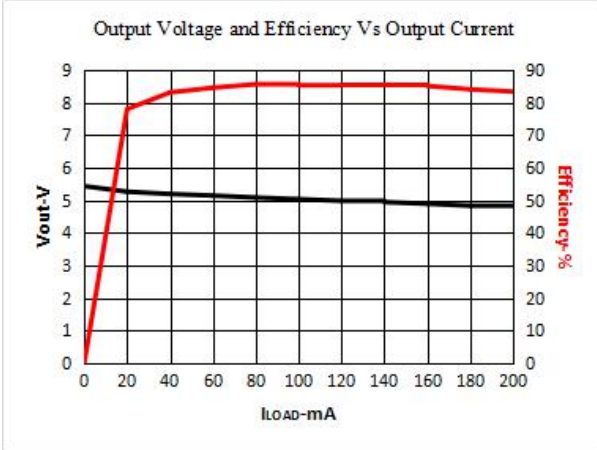
SCM1208BTA is a full-bridge power source controller with integrated power MOS tube. The chip can work normally under the low input voltage of 4V, and will not be damaged under the impact of 9V high input voltage for 1S. SCM1208BTA consists of two drives, each of which controls one direction of the current in the primary winding. Each road includes a power PMOS tube and a power NMOS tube. When opening PMOS tube and NMOS tube on one road, winding drive in one direction is selected; when opening PMOS tube and NMOS tube on another road, transformer winding drive is selected in the other direction. The full bridge control of the original side can be realized by choosing two drives alternately. The original side of the transformer only needs one winding.

The internal power MOS tube has a high degree of driving symmetry, thus reducing the magnetic bias of the full bridge topology. The chip also integrates three key technologies to improve reliability. The first is the soft start function, which avoids the impact of high current during startup and damages the device, and ensures normal startup with full load in CC load mode. The second is integrated output short-circuit protection, the protection consistency is good, not affected by the power processing parameter deviation, also not affected by high and low temperature test conditions; The third is overtemperature protection. When the temperature exceeds the specified range, the chip automatically enters the hibernation state. If the temperature drops to the set value again, it can automatically recover.

Typical Application Circuit



Function Curves



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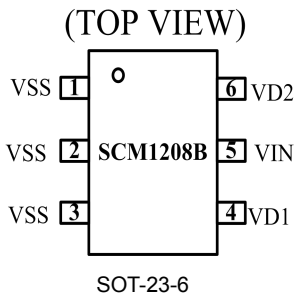
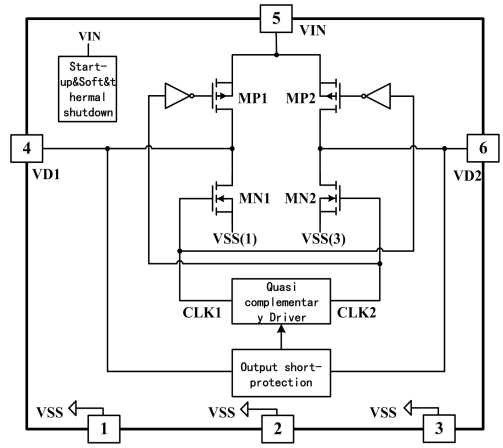
Pin Configuration



SOT-23-6

Inter Block Diagram



Pin Description

Pin Number	Name	I/O	Description
1	VSS	I	Device ground.Connect this pin to board ground.In application,it is better to connect the pin 1 and pin 3 together with the device with good heat dissipation performance,so that the internal heat of chip can be quickly conducted out.
2	VSS	I	
3	VSS	I	
4	VD1	I	The drain of the built-in power LDMOS tube drives the transformer windings in a quasi-complementary manner (i.e. there is a small dead time between the two drives). When the leakage voltage of the LDMOS tube is greater than the short-circuit protection value inside the chip, the chip becomes soft drive, that is, the saturation current of the LDMOS tube is limited. If continuous Toose detects that the on-off voltage of LDMOS tube is greater than the short-circuit protection country value, the chip will enter the hibernation state, the rest time is TsLEe, and restart again after the rest.
5	VIN	P	Chip power port.
6	VD2	I	The drain of the built-in power LDMOS tube drives the transformer windings in a quasi-complementary manner (i.e. there is a small dead time between the two drives). When the leakage voltage of the LDMOS tube is greater than the short-circuit protection value inside the chip, the chip becomes soft drive, that is, the saturation current of the LDMOS tube is limited. If continuous Toose detects that the on-off voltage of LDMOS tube is greater than the short-circuit protection country value, the chip will enter the hibernation state, the rest time is TsLEe, and restart again after the rest.

Absolute Maximum Ratings

General test conditions: Free-air,normal operating temperature range (unless otherwise specified).

Parameters		Min	Max	Unit
Input Voltage	V_{VIN}	-0.4	10	V
Drain Voltage of MOSFET	V_{VD1}/V_{VD2}	-0.7	11	V
Operation Junction Temperature Range	T_J	-40	150	℃
Storage Temperature	T_{STG}	-55	150	

Soldering Temperature (Allowable reflow soldering temperature of chip within 10 seconds)			260	
Moisture Sensitivity Level	MSL	MSL3		
Rated Value of ESD	HBM		8000	V
	CDM		1000	
Continuous Power Dissipation	P_{TOT}		270	mW

Note: if the value exceeds the stress value listed in the table's "maximum value" ,it may cause permanent damage to the components.If the product operates in the maximum rated condition for a long time,the reliability of the components may be affected.All voltage values take GND as basis reference.The current refers to the current between positive input and negative output of the specified terminal.

Recommended Operating Conditions

Unless otherwise specified,the following parameters are measured in the conditions of V_{VIN}= 5V.

Parameters		Min	Max	Unit
Input Voltage	V_{VIN}	4	6	V
Drain Voltage of MOSFET	V_{VD1}/V_{VD2}	-0.7	9	V
Output Switching Current of Primary Winding	I_{D1},I_{D2}		580	mA
Operation Junction Temperature	T_J	-40	125	℃

Thermal Resistance Information

Heating current is 1A and heating time is 300s,test current is 10mA and test time is 300s.

Parameter		Value	Unit
Junction-to-ambient thermal resistance	θ_{JA}	196	℃/W

Note: Because SOT-23-6 has small packaging size,thermal resistance between components and board θ_{JB} and thermal resistance between components and shell θ_{JC} have no reference value for system design.The reference standard is JESD51-1.

Electrical Characteristics

Unless otherwise specified,V_{VIN}= 5V and the environment temperature is 25°C.

Symbol	Corresponding Parameters	Test Conditions	Min	Typ	Max	Unit
Supply Section (VIN Pin)						
V_{VIN}	Voltage operating range		4		6	V
I_{RUN}	Operating Current of Chip	VD1 pin and VD2 pin are suspended		1.8	2.3	mA
I_{START}	I_{VIN} when V_{VIN} is in under-voltage lockout	V_{VIN}=2V		205	246	μA
V_{VIN_ON}	Start-up Voltage	V_{VIN} voltage increasing		3.1	3.41	V
V_{VIN_OFF}	Voltage when $V_{IN}$is in under-voltage lockout	V_{VIN} voltage decreasing	2.05	2.28	2.51	V
T_{OTP}	Temperature of Over-temperature Protection			155		℃
T_{OTPH}	Return Difference of Over-temperature Protection			30		℃
Drain Port of MOSFET (VD1/VD2 Pin)						
B_{VDSS}	Breakdown Voltage of MOS Transistor	V_{VIN}=0V,I_{DS}=100uA	13	14.5		V
R_{NDS_ON}	On Resistance of NMOS	T_J=25℃,I_{DS}=0.5A		0.1	0.5	Ω
		T_J=100℃,I_{DS}=0.5A		0.12		
R_{PDS_ON}	On Resistance of PMOS	T_J=25℃,I_{DS}=0.5A		0.22	1	
		T_J=100℃,I_{DS}=0.5A		0.27		
I_{SOFT}	Current of Soft Start	V_{VD1}=V_{VD2}=3V	464	580	900	mA
Internal Time						
F_{OSC}	Operating Frequency	VD1、VD2 hang in the air	280	300	328	kHz
T_{DEAD}	Dead Time	Resistor=500Ω 1W connected between VD1 and VD2	100	150	180	ns
Tr	Rise time	VD1、VD2 The pin is suspended		3.9	5.1	ns
Tf	Fall time	VD1、VD2 The pin is suspended		3.9	5.1	ns
T_{D_OSP}	Delay Time of Short Circuit Protection	F_{OSC}=315kHz	54.4	68	81.6	ms
T_{SLEEP}	Sleep Time of Short Circuit Protection	F_{OSC}=315kHz	496	620	744	ms

Typical Performance Curves

Unless otherwise specified,the following typical characteristic curves are obtained in the conditions of V_{VIN}=5V and T=25℃.Typical performance curves are obtained by testing the test circuit shown in Figure 5.

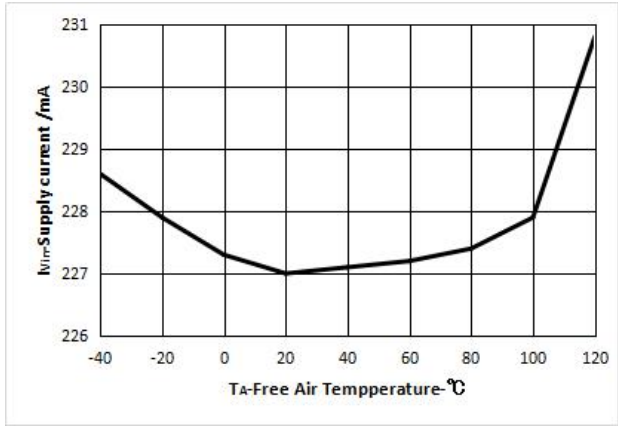


Figure 1 Average Supply Current of VIN VS Free Air Temperature

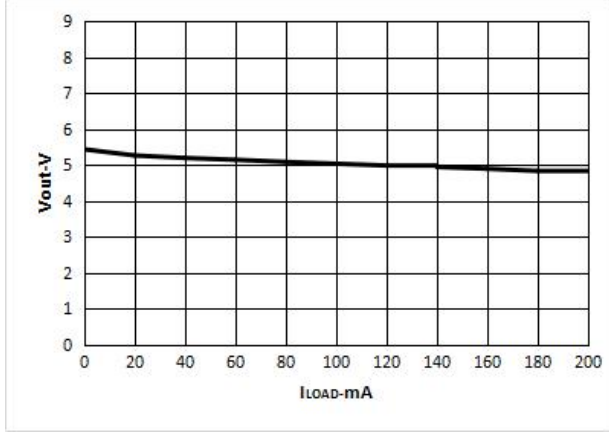


Figure 2 Relationship between Output Voltage and Load Current

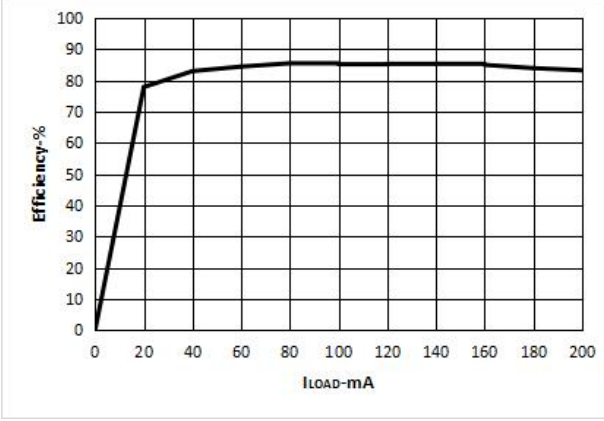


Figure 3 Efficiency and Load Current

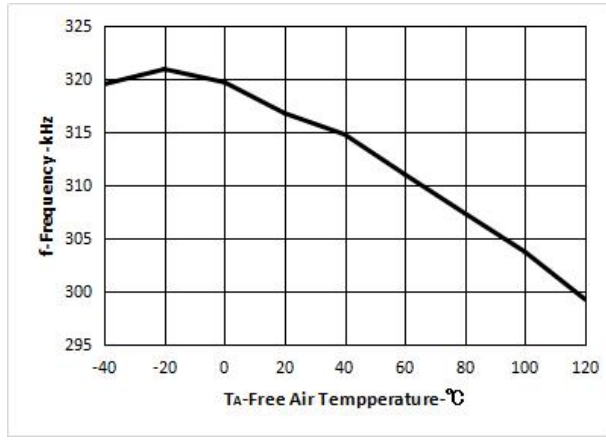


Figure 4 Switching Frequency of MOS Transistor VS Free Air Temperature

Parameter Measurement Information

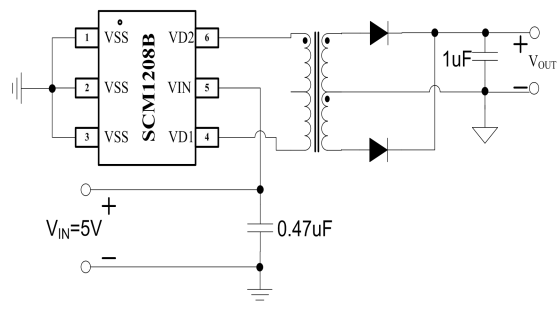


Figure 5 Schematic Diagram of Test Circuit for Function Curve

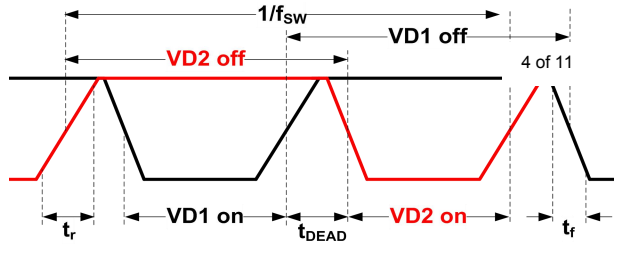


Figure 6 Circuit Sequence Diagram

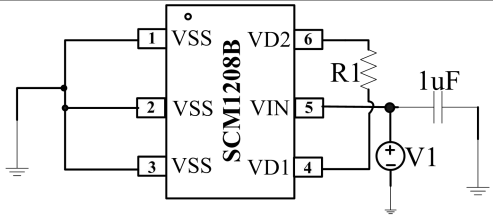


Figure 7 Schematic Diagram of Test Circuit for Switch Characteristics

Product Operation Mode

SCM1208BTA has three operation modes,which respectively are start-up mode,operation mode and short mode.

In start-up mode,SCM1208BTA provides sufficient charging time for output capacitor,to avoid the abnormal start caused by output short circuit which is incorrectly identified due to the excessive low voltage of output capacitor when it is just started,at the same time,the MOS transistor in start-up mode is always operating in current-limiting drive status which means that the drive voltage of MOS transistor in start is limited,thereby making the current flowing through MOS transistor restrained within the safe range of components,that is to restrain the output switching current of primary winding to I_{SOFT} to achieve the soft start of the system,thereby avoiding the over-current impact and the generation of excessive heat.

In operation mode,MOS transistor is always in full drive status which means that the MOS transistor is operating in switching status and the breakover voltage is very low,which guarantee the efficiency of converter.

In short mode,it will stop driving the converter in sleep mode and the heat generated in start-up mode will be dissipated,then the product changes to start-up mode.

The three operation modes can be freely switched.Only when there is abnormality of output short circuit,the product will repeatedly switch between the start-up mode and short mode,when the abnormality disappears,the product will automatically change to operation mode,all of which can fully guarantee the reliability of converter and have no influence on the performance of converter in normal operation.

Start-up Mode

The voltage of output capacitor is zero when the converter is just started,and the converter is firstly in start-up mode.The flow diagram is shown in Figure 8,that is,start → Drive the selected MOS transistor in current-limiting drive method → check the switch-on voltages of MOS transistors(V_{VD1},V_{VD2}) → judge whether the voltages (V_{VD1},V_{VD2}) are more than the set value.

If (V_{VD1},V_{VD2}) are more than the set value,then calculate the duration of over-voltage→ judge whether the duration is more than T_{D_OSP} (620ms,typ,).If yes,then the system turns into short circuit mode,if no,then the above process is repeated.

If (V_{VD1},V_{VD2}) are not more than the set value,then the system turns into operation mode.

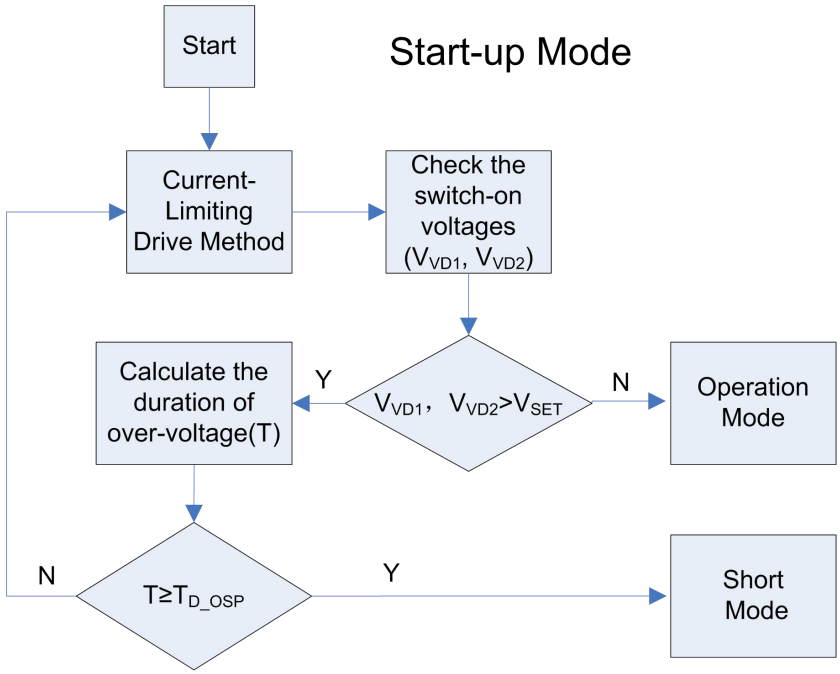


Figure 8 Flow Diagram of Start-up Mode

Operation Mode

If the output of converter has no short circuit,the voltage of output capacitor,in start-up mode,will gradually increase during the continuously circular charging.When the breakover voltage of MOS transistor is less than or equal to the set value,the converter will turn into operation mode.The flow diagram is shown in Figure 9,that is,determine that the breakover voltage of MOS transistor is less than or equal to the set value→ drive the selected MOS transistor with full drive→ check the switch-on voltage of MOS transistors→ judge whether the voltages (V_{VD1},V_{VD2}) are more than the set value.

If the breakover voltage of MOS transistor is more than the set value,then the system goes into time-counting cycle of start-up mode,otherwise,the system turns back to the step “drive the selected MOS transistor with full drive”,and the above processes are repeated,which is the normal operation of the converter after the product is started.In the operation,MOS transistor is fully driven,that is the MOS transistor is operating in switching status and the on resistance is low,resulting in low energy consumption and high efficiency.

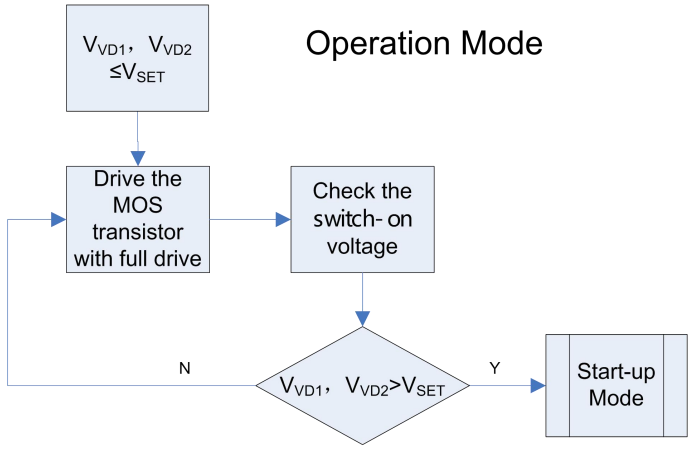


Figure 9 Flow Diagram of Operation Mode

Short Mode

If the output of the converter has short circuit,it will detect in start-up mode that the breakover voltage of MOS transistor is more than the set value,then the accumulated over-voltage time will definitely exceed T_{D_OSP} (68ms,typ.).At this time,SCM1208BTA will stop to drive the MOS transistor and begin to count the time of stopping driving MOS transistor.When the time is counted to T_{SLEEP} (620ms,typ.),the product resumes operation and turns into start-up mode.

The flow diagram of short mode is shown as Figure 10: determine the duration of over-voltage exceeding T_{D_OSP} → stop driving and begin to count time (sleep mode) → finish counting time → turn back to start-up mode.We can see that if the converter is always in output short circuit status,it will operate in the short mode and start-up mode alternately.

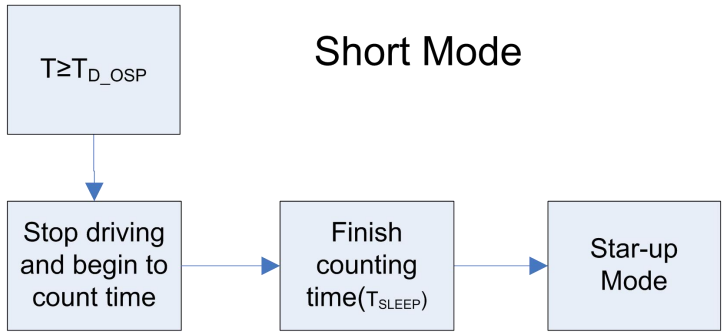


Figure 10 Flow Diagram of Short Mode

Extended Output Design

SCM1208BTA chip is used to drive the push-pull circuit,which can make output voltage become higher.

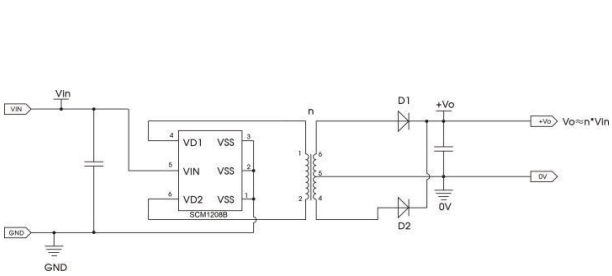


Figure 11 Extended Circuit I

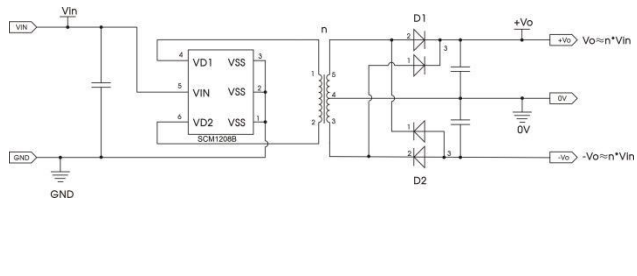


Figure 12 Extended Circuit II

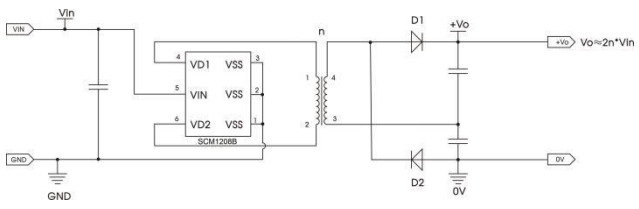


Figure 13 Extended Circuit III

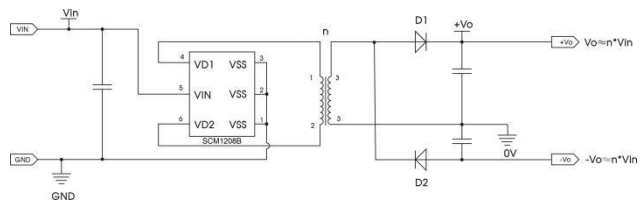


Figure 14 Extended Circuit IV

Application Circuit

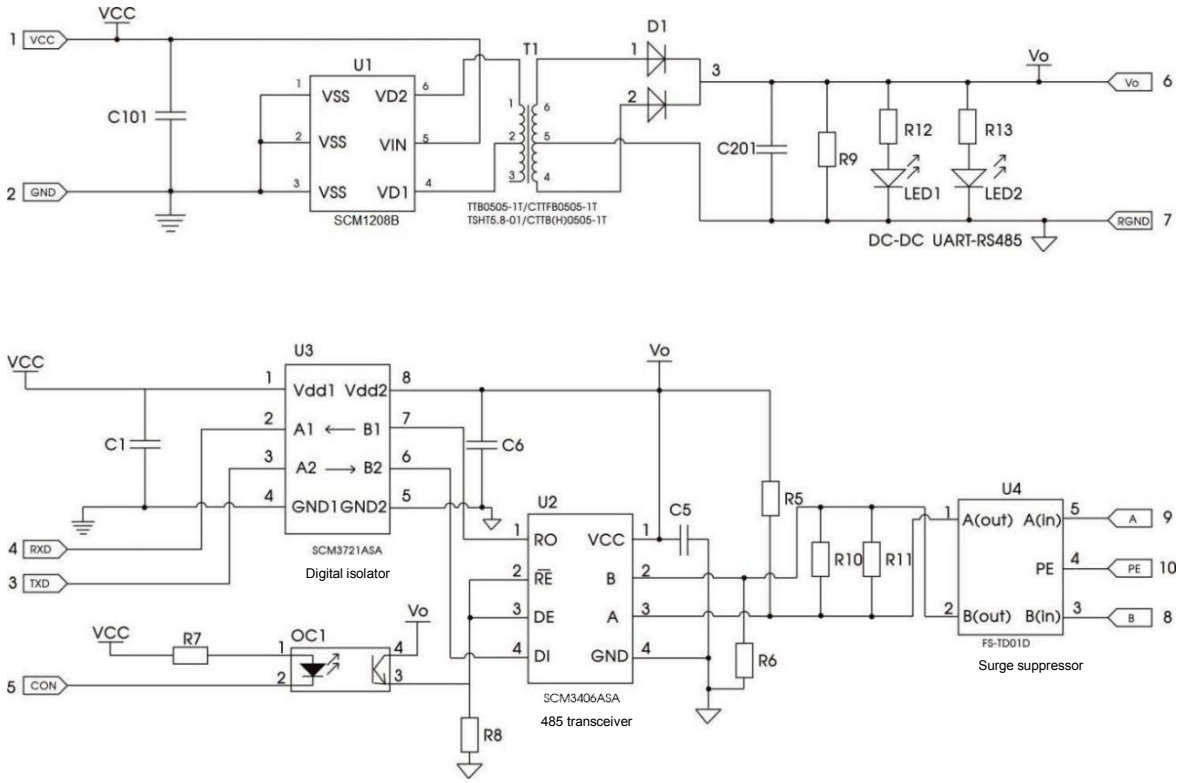


Figure 15 Application Circuit I

(1) Introduction of TTB05xx-1T Transformer

With the voltage of primary winding and secondary winding of 1650VDC,the allowable working temperature of -40℃~+125℃ and the packaging size of 6.50 x 8.80 x 3.60mm,combined with design of our ICSCM1208BTA product,TTB05xx-1T transformer can be used for electrical isolation scenario which is applicable to 5VDC input and output power less than 1W,such as digital circuit,analog acquisition circuit and data exchange circuit.Please log in the official website of Mornsun and contact the salespeople to obtain the specific specification.

(2) Introduction of TSHT5.8-01 Transformer

TSHT5.8-01 transformer,with the packaging size of 12.50 x 8.70 x 5.90mm,is specially designed for use with IC.It is mainly used for the electrical isolation scenario which is applicable to 5VDC input and 5VDC output power less than 1W,such as digital circuit,analog acquisition circuit and data exchange circuit.

Suggested Use Of Power Supply

Unless otherwise specified,the following parameters are measured in the conditions of V_{VIN}= 5V.

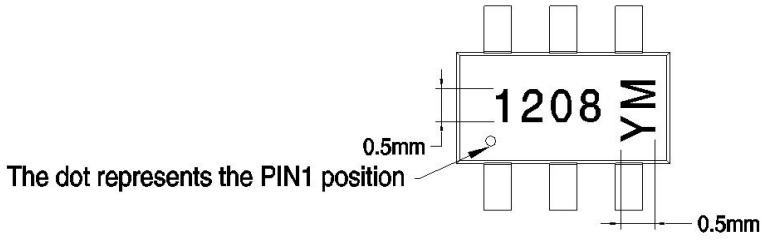
If the input power is not stable enough,it is suggested to add 1uF capacitor in the first section of IC SCM1208BTA,if there is high requirement to EMI performance,add capacitor and inductor in the first section of the module to filter noise,if there is high requirement to no-load voltage,add resistor after the filtering capacitor of the module as dummy load,it is suggested that the connecting wire of IC4 and 6 pins to the transformer is as short as possible.

Ordering Information

Product Model	Packaging	Quantity of Pin	Silk Screen	Packing
SCM1208BTA	SOT-23-6	6	1208YM	3K/tray

Description of Product Model
SCM1208XYZ:
(1) SCM1208,product code.
(2) X = A-Z,version code.
(3) Y = T,packaging code,T: SOT packaging
(4) Z = C,I,A,M,code of temperature range,C: 0℃-70℃,I: -40℃-85℃,A: -40℃-125℃,M: -55℃-125℃.
(5) YM: Date code for product traceability; Y = code for production year; M = code for production month.

Silk Screen Information



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2、Character size:
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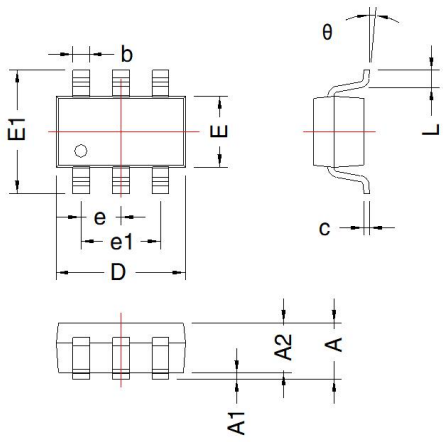
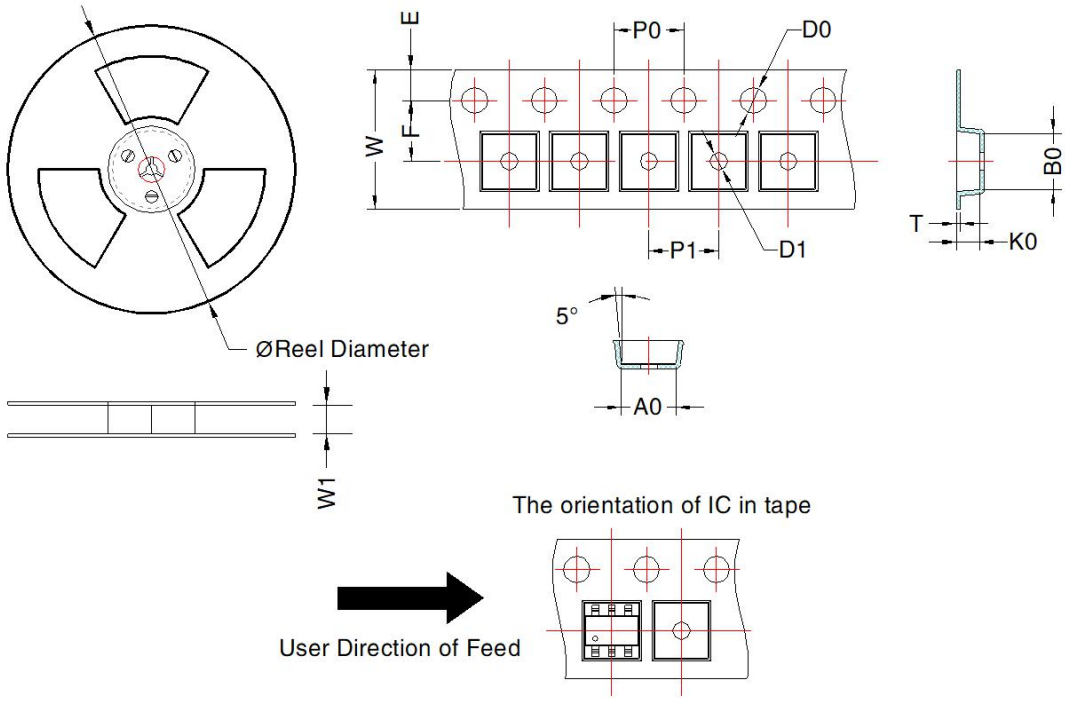
Package Information

THIRD ANGLE PROJECTION



Mark	SOT-23-6			
	Dimension(mm)		Dimension(inch)	
	Min	Max	Min	Max
A	0.90	1.25	0.035	0.049
A1	0	0.15	0	0.006
A2	0.70	1.20	0.028	0.047
D	2.70	3.10	0.106	0.122
E	2.50	3.10	0.098	0.122
E1	1.50	1.70	0.059	0.067
L	0.30	0.60	0.012	0.024
b	0.3	0.5	0.012	0.02
e	0.95 TYP		0.037 TYP	
e1	1.90 TYP		0.075 TYP	
c	0.08	0.2	0.003	0.008
θ	0°	8°	0°	8°



Device	Package Type	MPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	T (mm)	W (mm)	E (mm)	F (mm)	P1 (mm)	P0 (mm)	D0 (mm)	D1 (mm)
SCM1208BTA	SOT-23-6	3000	180.0	8.5	3.17	3.23	1.37	0.25	8.0	1.75	3.5	4	4	1.5	1.0

Note: The minimum order quantity is the minimum packing quantity, and the order quantity shall be an integral multiple of MPQ.

MORNSUN Guangzhou Science & Technology Co.,Ltd.

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